In the next section these provisions will be evaluated to show how they may impact on the protection of nanotechnology and if the patent system, as it is defined today, promotes researchers and institutions entering into challenging projects related to basic science in the field of nanotechnology. These questions will be approached by analyzing the rules of the current system for examples of instances where basic research is essential to develop uses and applied solutions from nanotechnology.

2. Inventions and discoveries

Basic research is defined as the investigation conducted with the main purpose of discovering new issues or to develop theories about natural phenomenon.[18] The knowledge generated by this activity is in many cases non-patentable, either because it is simply excluded as patentable subject matter or because it fails to fulfill the other basic patentability requirements.

Article 52 of the EPC states that a patentable invention includes "[…] any inventions, in all fields of technology, provided that they are new, involve an inventive step and are susceptible of industrial application."[19] The Convention doesn't define what an invention is, nevertheless it provides a non-exhaustive list with examples of what doesn't constitute an invention.[20] According to this provision, discoveries and scientific theories are not considered inventions and therefore excluded from patentability.[21] While EPC is clear on the point that a discovery is not patentable, it is silent on the definition of discovery. In this regard, the European Patent Office (EPO) has provided some clarification on what constitutes an invention under Article 52(2), but it has not provided any formal definition for the word *discovery*, obliging a case by case analysis in order to asses the requirement with regard to each particular technology.[22]

It appears that EPO has not dealt in depth with the clarification of a general definition seems to be because patentability concerns in connection with discoveries were approached from different perspectives. This may be due to the difficulty associated with providing a general rule on the understanding of the meaning of *discovery*. These alternative approaches have centered on the development of the

18 Merriam-Webster Online Dictionary. http://www.merriam-webster.com/dictionary/research (last visited May, 2009)

19 EPC, Article 52, Patentable Inventions.

20 *Id.* at (2).

21 *Id.* at (2)(a).

22 *See*, for example, V 0008/94.

novelty requirement and on the nature of the technical character contained in the invention. This last indirect requirement, the technical character of the invention — discussed at length in cases related to biotechnological inventions and other fields— has been developed as a test to define what constitutes an invention.[23] Nevertheless, while the restriction on patentability of discoveries is designed to avoid patenting of laws of nature and basic concepts of science, considered to be in the public domain to allow a general and unrestricted use of them,[24] not all inventions based on a discovery are excluded from patentability.[25]

It is clear that the basic laws of nature governing the functioning of nano-technological inventions are not subject matter eligible to be patented as they are considered scientific theories, explicitly excluded as such by the EPC and lacking of technical character.[26] Most of the time, this restriction is not a problem for inventors, given that what is discovered or invented is not the law of nature allowing, for example, nanotubes to perform in a way completely different to the way a normal sized hollow fiber would perform, but it is the structure of the nanotube itself which makes the invention patentable. In many cases, the inventor is not aware of what makes the invention to perform in a particular way nor able to explain the scientific principle behind the behavior of the invention; nevertheless in the case of nanotechnology, researchers are working close to an undistinguishable line between discovering new properties of matter and developing new materials or devices. In any case, given the complexity of nanotechnology in terms of the knowledge needed to manipulate it, inventors are often very knowledgeable about scientific concepts that allow them to find applications and develop patentable inventions. The process of research and development may flow in two directions: from the development of the invention to the research and modeling of the properties presented by the invention or, in the opposite directions, from the discovery of the scientific principle to the development of the use of such knowledge in an invention. In some environments the latter may be favored and promoted, leading to the generation of discoveries and scientific knowledge that may be difficult to patent. This is mostly true for researchers working with nanotechnology at universities, where the generation of knowledge is one of the primary objectives of the institutions. This is in stark contrast to the research carried out by companies where the main objective is usually to develop a product to obtain a financial or economic return on such

23 *See*, for example, T 0619/02 for a discussion on the technical character of an invention related to an "Odour evaluation method".

24 As indicated by the EPO in case T 0870/04, "The purpose of granting a patent was not to reserve an unexplored field of research for an applicant."

25 *See*, G 0002/88. In this case, the TBA affirmed this point by clarifying "[...] the fact that the idea or concept underlying the claimed subject-matter resides in a discovery does not necessarily mean that the claimed subject-matter is a discovery "as such".

26 *Id. supra* note 19.

investment. In this way, researchers at the universities may be creating non-patentable knowledge that is then used by others to create inventions subject of patents. the issue of how knowledge developed by basic research may be subject of patents will be discussed further in the Thesis.

Recently, universities and pubic research institutions have started to play a significant role as holders of important patents. For example, the Max Planck Society, a non-profit organization, has its own office in charge of patenting and commercializing inventions generated by its institutes, which in year 2004 accounted 115 running licenses, most of them based on patents.[27] A similar situation can be found in the US. After the enactment of the Bayh-Dole Act, the number of patents granted to Universities has increased considerably.[28] The ten universities receiving the most patents for inventions in 2005 amounted 1,294 grants, many of them with equivalents in European countries, which is a clear example of the certainty that universities are now commercializing, or willing to commercialize, the technology that they produce.[29] The relatively recent tendency of universities in filing more patents may be influenced by several factors. One of them is the need for external financing. Another is the need to retain researchers by allowing them to generate further income apart from what they earn as a salary. Some universities share the financial benefit generated by the exploitation of a patent in thirds among the university, the researcher and the Technology Transfer Office. Yet another reason relates more to the pressure that society places on the academy to show the manner in which the taxes they pay are used to generate useful knowledge that then is given back to the society in the form of technology to solve real problems. It is probable that society in general supports the idea of universities filing patent applications more because patenting is perceived as proof that researchers are working on solutions to real problems and not on basic research, popularly considered as less useful, rather than because patenting is going to increase availability of the technology. Some arguments could be made in favor of the idea that by patenting new technologies, universities are favoring to put those inventions to use in a way beneficial for the society; however, Technology Licensing Offices

27 Hertel Bernhard, Class lecture, Science, IP & Start Ups, Munich Intellectual Property Law Center, Munich, Germany, , April, 2008.

28 Bayh-Dole Act is codified in 35 U.S.C. § 200-212. The statute allows US Universities to take control of the inventions generated from research founded by the Government. For a general discussion on the implicances of the enactment of the Bayh-Dole Act, *see* Mowery, David C., Nelson, Richard R., Sampat, Bhaven N. and Ziedonis, Arvids A., *The Growth of Patenting and Licensing by U.S. Universities: An Assessment of the Effects of the Bayh-Dole Act of 1980*, Research Policy, Vol. 30, pp. 99-119, 2001.

29 USPTO, Press Release #06-24, April 2006. Available at http://www.uspto.gov/web/offices/com/speeches/06-24.htm (last visited September, 2009).

usually use managing indicators such as number of patents filed, number of licenses granted and earnings from royalties. This shows that the financial benefit is the main objective of the enterprise. If making the technology available to society in general were the objective of universities, they would put any generated knowledge in the public domain and allow others to use and improve upon that technology. Even if high investment is needed to put the invention in the market and we assume that patents facilitate putting inventions to use, third parties may still have the possibility to patent manufacturing process or specific uses of such technology in a way that investing in commercialization is also promoted.

However, much of the knowledge generated by universities is widely disclosed and placed in the public domain, as they are able to appropriate the benefits of research only to a limited degree, and only a limited portion of such knowledge in the field of nanotechnology can be patented. That knowledge, considered as valuable by the market, may include basic laws of physics or chemistry but also, and most importantly, the description of mechanisms and theoretical foundations on why nanostructures enjoy different properties compared to equivalent normal sized structures and the models and methodologies to predict such behavior.

It is strange that open patent licenses, similar to those now popular for software, are not widely used by more universities and publicly founded research projects teams. In any case, it is clear that people and organizations working in basic research have less control on how that information is later exploited, whether to impede its use or to oblige developers of new technology incorporating that knowledge to allow its use under an open license.

3. Non patentable knowledge

According to the EPC, there is no requirement for the applicant to explain why the invention works or to provide a theoretical model to allow the public to understand the functioning of the invention. The only requirement regarding disclosure is to include in the patent description the information needed to allow a person skilled in the art to put the invention at use.[30] In this way, much information related to the invention stays out of the patent document. However, in some cases the applicant may be forced to disclose the theory behind the invention to fulfill the disclosure requirement. EPO's case law indicates that "if the invention seemed, at least at first, to offend against the generally accepted laws of physics and established theories, the

30 EPC, Article 83, Disclosure of the Invention, requires that "the European patent application shall disclose the invention in a manner sufficiently clear and complete for it to be carried out by a person skilled in the art".